

# What can we learn from each other ? Research and tradition





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#### Japan and Germany



- Long tradition of healing with water
- (Economic) success by adaption to changes and challenges
- Nature (forest, climate) as healing factor (shinrinyoku)
- Similar mineral waters (high CO2)
- Higher water temperatures in Japan
- Health resorts with proven quality in Germany

# Summary of this lecture



- I want to show some results of recent research and discuss possible solutions and cooperation
  - Balneotherapy and CO2 in peripheral artrial diesease
  - Hyperthermic baths and Sauna
  - Thermoneutral baths with and without exercise
  - Forest medicine shinrin-yoku
  - Health resorts in Germany
  - Drinking mineral waters and dementia
    - Silicea, Lithium Magnesium,





## Balneotherapy in Peripheral Arterial Disease

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# CO2 baths: physiologic basis



- Increase of cutaneous blood flow, peripheral vasodilation
- Catecholamine plasma levels decrease
- Decreased sympathetic an increased parasympathetic activity
- Thermal sensation score increases (blockage of cold receptors?)
- Bohr effect (rightward shift in O<sub>2</sub> dissociation curve)
- NO-elevation, activation NO-cGMP pathway
- Induction of local VEGF

Carbon dioxide balneotherapy and cardiovascular disease. Pagourelias ED et al. Int J Biometeorol. 2011 Sep;55(5):657-63.
Carbon dioxide-rich water bathing enhances collateral blood flow in ischemic hindlimb via mobilization of endothelial progenitor cells and activation of NO-cGMP system. Irie H, Circulation. 2005 Mar 29;111(12):1523-9.
Effects of immersion in water containing high concentrations of CO2 (CO2-water) at thermoneutral on thermoregulation and heart rate variability in humans. Sato M Int J Biometeorol. 2009 Jan;53(1):25-30

Balneotherapy in Peripheral Arterial Disease



- Carbondioxid baths, water and gas, thermoneutral
  - 4 RCT, 2 blinded, 4 OS
- Radon, water, hyperthermic, 1 RCT, n=128, diabetes)
- Waon Sauna (2 OS, n=20, n=21)
- Hydrotherapy (Contrast showers 1 OS n=20)
- Sulphur baths (homcysteine 1 RCT, not blinded n=40)
- Galvanic baths (1 CT, not randomized, not blinded, n=111)
- Hypnosis (1 OS, n=18)

All trials show positive results

# Natural CO<sub>2</sub> gas baths

 RCT, n=62, intermittent claudication (100-500 meters, moderate Fontaine stage II) constant temperature of 30°C on pre-humidified skin. •18 consecutive days of

- CO2 gas treatment
- placebo (air).

Figure 1: Treatment (pre-humidified skin) Bath of tap water for 10 minutes at a temperature of 34-35°C

Figure 2: Treatment (CO<sub>2</sub> or placebo) Application of CO<sub>2</sub> or placebo for 35 minutes over 80% of the body surface







(Spa of Royat, France)

# Natural CO<sub>2</sub> gas baths



CO<sub>2</sub> gas treatment after 18 days with significant increase in

•total distance walked (+ 131 meters, 66%; p = 0.001)

•pain-free distance (+ 81 meters, 73%; p = 0.02)

improvement maintained after 3 and 12 months

•systolic pressure index (ABI) increased by 37% (p = 0.001) 1 min after treadmill walking

•ABI recovery time decreased by 38% (p = 0.002).

•increase in systolic pressure of the great toe (13%; p < 0.0001), in baseline pO2 (20%; p = 0.01) and in vasomotion (78%; p = 0.001)

No significant change was observed in the placebo group.



**Figure 3:** Changes in total walking distance (mean value  $\pm$  SD, meters) Total distance on inclusion is mean value for each patient of measure ments recorded during treadmill tests 1 and 2 before randomisation. p = 0.001 for group 1, before / after treatment at each measuring time intergroup p values = 0.001 after treatment at each measuring time

Clinical and microcirculatory effects of transcutaneous CO2 therapy in intermittent claudication. Randomized double-blind clinical trial with a parallel design. Fabry R, Monnet P, Schmidt J, Lusson JR, Carpentier PH, Baguet JC, Dubray C. Vasa. 2009 Aug;38(3):213-24.





# Effects of hyperthermia on depression

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#### Hyperthermia effects

- Acitivates immune system
  - Heat shock proteins
- •Regulates vegetative system
- •Affects sleep



# Hyperthermia effects in oncology



Oncotarget 2016 Aug 30;7(35) : 57367-57378. Local hyperthermia in head and neck cancer: mechanism, application and advance. Gao S

Heat sources used for hyperthermia purposes and different mechanisms induced by locally heating tumors. The mechanism of killing tumor cells *via* the following aspects: (1) Direct cell-killing effects of HT alone (red); (2) Anti-neoplastic effect coordinated with radiotherapy and chemotherapy (blue); (3) Immune modulation (purple).

Hyperthermic Baths (HTB)



•Head-out-of-water-immersion in a 40°C pool

- •duration until discomfort (30 minutes)
  - Mean duration 22.6 (± 3.5) min
- •Afterwards wrapped in warm blankets with 2 hot water bottles for at least 30 minutes
- •4 weeks with 2 interventions per week



Keidel-Bad Freiburg

#### HTB and Depression



- •Non-controlled study
- •20 depressive patients

# •Improvement in the 21-item Hamilton Depression Scale (HAMD) after five baths.

Schaper LC. Wiederholte Hyperthermiebehandlung durch Überwärmungsbäder bei Patienten mit depressiven Störungen: Effekte auf die Produktion von Interleukin-6 sowie auf die mittlere Körpertemperatur und den psychopathologischen Befund. 1996.

#### Non-controlled study in depressive patients

#### •Effects on Heart Rate Variability (HRV)

Gödl, R. 2000. "Veränderungen Der Autonomen Regulation Durch Überwärmungsbadtherapie Bei Patienten Mit Depressiven Störungen. (Unpublished Doctoral Dissertation, University of Graz, Austria)." Medizinischen Fakultät der Karl-Franzens-Universität Graz.

#### HTB vs sham light treatment



Pilot study, parallel-group, randomized controlled trial
36 depressed patients with Hamilton Scale for Depression (HAM-D) total score ≥ 18 (mean HAM-D 22.4)

- 17 HTB
- 19 sham green light
  - < 400 Lux by an LED, < 40 min in a sitting position

Naumann J, Sadaghiani C, Grebe J, Kaiffel S, Huber R. Effects of hyperthermic baths on depression, sleep and heart rate variability in patients with depressive disorder: a randomized controlled pilot trial BMC Complement Altern Med. 2017 Mar 28;17(1):172

#### HTB Core body temperature

(Ear thermometer after ca. 22 min)

- 36.6°C
- Directly after bathafter rest

Before bath

39.1°C (mean change 2.43 K) 37.7°C (mean change 1.06 K)







effect size Cohen d = 0.72

4 weeks after treatment effect size Cohen *d* = 0.33

# HTB severity of depression

Greater improvement

•With more severe depression

- HAM-D > 22 at baseline
  - difference in HAM-D scores of 6.17
- HAM-D > 26 at baseline
  - difference in HAM-D scores of 10.8

•In group with antidepressants

Threshold for clinical significance of the National Institute for Clinical Excellence (NICE):

treatment-placebo difference of 3 points on the HAM-D



# HTB Adverse effects



reported by 21 participants
12 (86%) in the HTB group
9 (56%) in the control group
No serious adverse events

But: HTB are an important cause of sudden death in Japan, Temp of hot baths 42°C and more

#### HTB vs Physical exercise



Pilot study, parallel-group, randomized controlled trial
45 depressed patients with Hamilton Scale for Depression (HAM-D) total score ≥ 18 (mean HAM-D 21.7)

- 22 HTB
- 23 Physical exercise
  - in groups moderate intensity aerobic exercises

Naumann J, et al. Effects and Feasibility of Hyperthermic Baths for Patients with Depressive Disorder: A Randomized, Controlled Clinical Pilot Trial. (Under peer review in American Journal of Psychiatry)

#### HTB vs Physical exercise

Sign. and relevant
improvement of depression
and sleep after 2 weeks (ITT)
HAM-D 4.3
BDI 7.5
PSQI 2.0

45

40





# Hyperthermia methods

Exogen
Hyperthermic Baths
Infrared Light, Sauna
Capacitive fields
Microwaves

#### Endogen

•Misteltoe (Lectins)

•cell extract of gram neg bacteria





https://www.heckel-hyperthermia.com/index.php/ en05#gallery9ddb70d768-1

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#### Correlations of effects and methods



standardized mean change for the treatment group (δT)

Red= seriell intervention



#### Correlations of effects and methods



of effect and

- Correlations of effect and
- •A:max. body core temperature
  - Orange=rectal;
  - green=sublingual
  - red=tympanic
- •B: treatment time (minutes)
  - Orange=infrared light
  - Green=baths
- •C: Endpoint (weeks)
  - Red= serial
  - Green=single intervention

•D: max. body core temperature and method to measure

#### K.U.Hanusch, published soon

Finish Sauna longterm effects

# 2000 people observed for 20 years Sauna visits per week 1x 2-3x 4-7x Risk for Sudden cardiac death 10% 8% 5%

- •Mortality by CVD
   22%
   16%
   12%

   •Overall mortality
   49%
   38%
   31%
- Risk reduction with frequent sauna
  40-50% to die 50% cancer
  60% for stroke 50% dementia
  35-40% for respiratory diseases

Laukkanen T, Khan H, Zaccardi F, Laukkanen JA. Association Between **Sauna** Bathing and Fatal Cardiovascular and All-Cause Mortality Events. JAMA Intern Med. 2015 Feb 23.



## Hyperthermia in depression Conclusions



- •May have a relevant effect (larger trials needed)
- •Larger effects in severe depression
- •Fast onset of treatment effects (IR-HT even immediate)
- •Less adverse effects than many antidepressants
- •HTB more helpful with antidepressant medication
- •IR-HT larger and longer lasting effects

Many open questions:

- •HTB or IR-WBH
- •Single or seriell intervention
- •Max. body core temperature ...

# Aquafitness-The new trend in Balneotherapy





Dr. med. Johannes Naumann European Institute for Physical Therapies and Balneology Freiburg, Germany, dr.j.naumann@gmail.com Exercise on land

#### Exerise is very healthy But weight is distress for joints and spine

350 kg



Aquafitness provides these aspects https://www.lifeline.de/galerien/





#### Training of mobility

Most important •Relief through floating •Relaxation do to thermoneutral or warm water •Slow movements

In acute conditionsDirect after operationsElder people







# Mobility of the knee after operation



Yellow Land Red water cycle

#### Gymnastic groups every day



| Uhrzeit   Tag     | Montag | Dienstag | Mittwoch | Donnerstag | Freitag | Samstag | Sonntag |
|-------------------|--------|----------|----------|------------|---------|---------|---------|
| 09.30 - 09.50 Uhr |        |          |          |            |         |         |         |
| 10.00 - 10.20 Uhr |        |          |          |            |         |         |         |
| 10.30 - 10.50 Uhr |        |          |          |            |         |         |         |
| 11.00 - 11.20 Uhr |        | ۲        |          |            |         |         |         |
| 11.30 - 11.50 Uhr |        | ۲        | ۲        | ۲          |         |         |         |
| 14.30 - 14.50 Uhr |        | ۲        |          |            |         |         |         |
| 15.00 - 15.20 Uhr |        | ۲        |          |            |         |         |         |
| 15.30 - 15.50 Uhr |        | ۲        | ۲        | ۲          |         |         |         |
| 16.00 - 16.20 Uhr |        | ۲        |          | ۲          |         |         |         |
| 16.30 - 16.50 Uhr |        | ۲        |          | ۲          |         |         |         |
| 17.00 - 17.20 Uhr |        | ۲        |          | ۲          | ۲       |         |         |
| 19.00 - 19.20 Uhr |        |          |          |            |         |         |         |
| 19.30 - 19.50 Uhr |        |          |          |            |         |         |         |

# Training of strength

Also Water resistance important

- Great variety of intensity •Aerobic
  - Aquafitness
- •Anaerobic
  - Aqua-Drill
- Resistance training for muscles
- •With or without contact to floor — Aqua-Jogging







Devices



**Enlarging surface** 

Larger devices –Aqua-Cycling –Aqua-Jumper



Additional motivation (music) –Aqua-Zumba



Aquafitness and overweight

- •No weight in the water – Relieves strain on joints
- •Water pressure
  - Improves respiration
  - More blood back to the heart
- •Better cooling
  - Even in water up to 34°C
  - Enables more intense training
- Less appetite after Aquafitness in thermoneutral water
  Improves blood cholesterol





Aquafitness in overweight own study



84 healthy participants, all overweight BMI > 25 kg/m<sup>2</sup>

- 3 groups, Exercise 20 times in 12 weeks
- •Aquafitness
- •Exercise in fitness center
- •Exercise at home

Aquafitness and fitness center better than exercise at home in

- •Fitness-test; 6-minutes-run-test
- loss of weight about 5kgquality of life
- Less problems with Aquafitness



Aquafitness in overweight with knee problems

87 overweight participants with knee problems

- 2 groups
- •Aquafitness
- •Exercise at home
- Less weight 10kg in 6 months
- Less pain in VAS 6,5 to 4,1
- No improvement in group with exercise at home

# Aquafitness for elderly

•Floating in the water – Lower risk of falls

- Vertigo improves
- •Water resistance
  - Mild training
  - Resistance adaptable anytime
  - Training with younger people easy

•Warm water

- Relaxation of muscles

•Water pressure

- Improves reflux of the blood
- Good for hypertension






# Forests, Shinrin-yoku and their importance for Health (Spa) resorts



Foto Eva Kempinger http://www.waldkurort.de/

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# Pathways through which contact with Nature relates to Health





# Pathways through which contact with Nature relates to Health





#### Air Quality



Trees reduce levels of air pollutants [e.g., ozone, oxides nitrogen (NOx), oxides of sulfur] and PM
reduce air movement

Pollutant Deposition and Uptake by Vegetation 47

|  |   | Moorland | Forest | % increase<br>forest/moor |
|--|---|----------|--------|---------------------------|
| Canopy height                                      | <i>h</i> (m)  | 0.15     | 10     | -                         |
| Zero plane displacement                            | <i>d</i> (m)  | 0.1      | 7      | -                         |
| Roughness length                                   | $z_{o}$ (m)   | 0.01     | 1.0    | -                         |
| Friction velocity                                  | $u * (m s^{-1})$                                    | 0.32     | 0.82   | 156                       |
| Momentum flux                                      | ∂ (N m <sup>-2)</sup>                               | 131      | 840    | 541                       |
| Maximum deposition<br>velocity for SO <sub>2</sub> | $V_{\rm max}$ SO <sub>2</sub> (mm s <sup>-1</sup> ) | 18.6     | 35.1   | 89                        |
| Maximum deposition<br>velocity for NO <sub>2</sub> | $V_{\rm max}$ NO <sub>2</sub> (mm s <sup>-1</sup> ) | 20.0     | 43.5   | 118                       |
| Maximum deposition<br>velocity for NH <sub>3</sub> | $V_{\rm max}$ NH <sub>3</sub> (mm s <sup>-1</sup> ) | 21.4     | 55.5   | 160                       |

#### Table 4.2 Potential effects of forests on deposition fluxes

#### Air Quality, Forrest (Schwarzwald)







Grafik: Typische NMVOC-Emissionen in den Monaten von Dezember bis März in Baden-Württemberg. Quelle: LUBW



# **Physical Activity**



promotes physical and mental health across the life span
Association of NE and physical activity
Children: positive in 40% of the studies
Older people: positive in 7 out of 8 studies
health benefits largest among the laziest

Importantindividuals'(perceived) safetyaccessibility

Hartig et al. Annu. Rev. Public Health 2014.35:20





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distance 0 km

distance 0.5 km

distance 1 km

distance 2 km

0.0

0.5

green area 30%



2,0

2,5

frequency of participation/week

3,0

3.5

4.5

5.C

4.0

1.0

1,5





positive association between social relationships and health and well-being association between social cohesion and •greenness of the neighborhood Sugiyama et al •quantity and even stronger quality of greenery. De Vries et al



# Stress reduction Influence on Cortisol







Fig. 2 Effect of walking in a forest park and walking in an urban area on the levels of systolic (a) and diastolic (b) blood pressure. Data are presented as the mean + SE (n = 16). \*p < 0.05, \*\*p < 0.01, significantly different between the forest and urban trips according to the paired t test

**Fig. 3** Effect of walking in a forest park and walking in an urban area on urinary adrenaline (**a**), noradrenaline (**b**), and dopamine concentrations (**c**). Data are presented as the mean + SE (n = 16 for adrenaline and n = 14 for noradrenaline and dopamine). \*p < 0.05, \*\*p < 0.01, significantly different between after and before according to the paired *t* test

Forest

Urban

# Effects of different NE

#### Ergebnisse / Basler Befindlichkeitsskala

#### AKTIVIERUNG – BERUHIGUNG



# subj. Empfindensausrichtung: Nach innen (1) vs außen (7)

#### VITALITÄT





Stein



Wasser



Wäldchen

#### NACH INNEN – NACH AUSSEN



# Wild or cultivated forest Design experimentelle Studie 1: in situ



Nicole Bauer – WSL - Tagung Wald + Gesundheit – 27.-29.10.2011 – Reichenau

### Wild or cultivated forest Vergleich zwischen Bedingungen



Wald "verwildert in situ"



Kovarianzanalyse, Kovariate t1, Abhängige Variable t2-t1; Irrtumswahrscheinlichkeiten:\* p<.05, \*\* p<.01, \*\*\* p<.001.



Nicole Bauer – WSL - Tagung Wald + Gesundheit – 27.-29.10.2011 – Reichenau a.d. Rax

# Forests in therapy

•Erholungswald recreation forest

- For all people, clean air
- •Kurwald "health forest"
  - Also ill people, secondary prevention, therapeutic walking, adequate infrastructure
- •Heilwald "healing forest"
  - Mainly therapeutic use, accessable only for the target group (patients), more special onfrastructure



# Conclusion



- The scientific literature relating to the effects of shinrinyoku is still limited.
- Forests have a positive influence on health and wellbeing of people living close to it.
- They have also a positive effect on health and wellbeing, if these places are visited for a certain even short time.
- Even artificial substitutes for forests show positive effects.
- Health resorts mainly situated in natural environments and forests can use the environment as helpful tools to achieve more physical activity and stress reduction in the general population and patients, esp. with chronic diseases related to lifestyle





# Medical spa treatment in Baden-Württemberg, Germany: A survey of spa physicians 2016

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# Health Resorts (HR) in Germany



Balneotherapy (onsen) is applied in villages comitted to the health = Health Resorts

Certified and controlled by the government (special laws)

Qualities of HR

- •Clean air, no noise, little traffic, nature
- •Culture, music, parks, hotels, healthy food, ...
- Medical institutions and staff
- •Physical therapies, Physiotherapy, Sauna, Inhalation,

# Balneotherapy in Health resorts



Balneotherapy uses local natural healing remedies

- •Thermal mineral water
- •Gases: CO<sub>2</sub>, radon, sulphure
- •Mud (peloids)
  - organic
  - anorganic (vulcanic stone powder with water)
- Climate



- •56 Health resorts
- •156 Health resort physicians
- Questionnaire to all physicians
- Interview per telephone with at least 1 Health resort physician per Health resort, possibly all.



state, that health resort medicine can relevantly contribute to solve big health problems as chronic pain, elder patients, overweight

but it is necessary to show the possible benefits to insurances, other physicians and patients.

# Indications in HR



- •Musculoscelettal system (back pain, osteoarthrosis)
- •Relatives of patietns visiting rehabilitaion clinics
- •Overweight
- •Respiratory disases, allergies





Outcome of patients excellent Relevant amelioration in 70 - >90% for nearly all indications

Esp. Musculoscelettal system

#### Effectiveness of natural remedies Judged by Health resort physicians



**Mineral Water/Bath Mineral Water/Drinking Cure** Medium Large Lery Large Notused Not used Little Large Little



#### Effectiveness of natural remedies Judged by Health resort physicians





# Health ressorts and Lifestyle change



Health ressorts are the ideal places

- •High attraction
- •High acceptance
- •High adherence
- Long tradition of teaching and curing
- •Experience with complex therapies for complex problems
- Salutogenetic principle

#### Chronic, lifestyle-related diseases





# A Place for Health ressort medicine

- •Acute and/or intense therapy: operation, syringes, ICU
- Intense, complex therapy for functional problems
- Intensity adapted complex therapy for complex problems, natural remedies and prevention
- •Minor problems, relaxation or activity is enough
- •All kind of problems, before and after the other therapies

- Hospitals
- Rehabilitation clinics
- Health ressorts with Medicine
   and/or Medical Wellness

- Holidays
- Ambulant medicine (therapies at home)









### Drinking water to prevent dementia Dr. med. Johannes Naumann European Institute for Physical Therapies and Balneology Freiburg, Germany

## Silicic acid and Alzheimer disease (AD)

**Risk reduction** with silicic acid in drinking water in 2 cohort trials from France between

**11%** for each **10 mg/day** more (n=3777)

**36%** for > **12 mg/day vs** < **12 mg/day** (n=383) Main source for silicic acid **mineral water** (silicic acid 8,8-35,7 mg/l),

Tap water contributed only with ca. 25%

(silicic acid 4,0-11,2 mg/l)

Water from Taketa (Naoiri) 230mg/l !

"Aluminum and silica in drinking water and the risk of Alzheimer's diseas decline: findings from 15-year follow-up of the PAQUID cohort". Rondeau al. 2009. *American Journal of Epidemiology* 169 (4): 489-96.

"Cognitive Impairment and Composition of Drinking Water in Women: Findings of the EPIDOS Study". Gillette-Guyonnet, et al 2005. *The American Journal of Clinical Nutrition* 81 (4): 897-902.





#### Meta-analysis silicic acid and AD





Test for subgroup differences: Not applicable

Silica intake ≤ 4 mg/d vs. > 12 mg/d vs.

(2) Silica intake ≤ 5.86 mg/d vs. > 15.45 mg/d vs.



2015 systematic review with meta-analysis 3 RCT n=232

Lithium significantly reduced mental decline of AD patients (SMD d = -0.41, 95% CI = -0.81 to -0.02, p = 0.04) (Matsunaga 2015).

This effect size is twice as large as the effect of approved drugs for the treatment of AD (Ströhle et al 2015).

"Lithium as a Treatment for Alzheimer's Disease: A Systematic Review and Meta-Analysis". Matsunaga, Shinji, Taro Kishi, Peter Annas, Hans Basun, Harald Hampel, und Nakao Iwata. 2015. Journal of Alzheimer's Disease: JAD 48 (2): 403-10. "Drug and Exercise Treatment of Alzheimer Disease and Mild Cognitive Impairment: A Systematic Review and Meta-Analysis of Effects on Cognition in Randomized Controlled Trials". Ströhle, Andreas, et al. 2015. The American Journal of Geriatric Psychiatry 23 (12): 1234-49.



#### Microdoses of lithium (0.3 mg per day) for 15 months

# reduced the mental decline of Alzheimer's patients small RCT

#### and in an animal model

"Microdose Lithium Treatment Stabilized Cognitive Impairment in Patients with Alzheimer's Disease". Nunes, Marielza Andrade, et al. 2013. *Current Alzheimer Research* 10 (1): 104-7.

"Chronic Microdose Lithium Treatment Prevented Memory Loss and Neurohistopathological Changes in a Transgenic Mouse Model of Alzheimer's Disease". Nunes, Marielza Andrade et al 2015. PLoS ONE 10 (11) https://doi.org/ 10.1371/journal.pone.0142267

#### Magnesium (Mg) and AD



- lower content of Mg of AD patients
  - in brain tissue (Glick 1990) (Andrási et al. 2005)
  - in the blood (Barbagallo et al. 2011)
  - in cerebrospinal fluid and hair (Veronese et al 2016)
- correlation of blood levels of Mg with the severity or the course of AD (Cilliler, Ozturk, and Ozbakir 2007)
- But: also elevated serum levels of magnesium in dementia (Kieboom et al., 2017)
- long-term increase in dietary magnesium intake has a positive influence on cognitive abilities (Cherbuin et al., 2014).
- case report: 2 x 500 mg magnesium daily dramatically improved the course of the disease for an AD patient temporarily (Glick and McMillan 2016).

Water analysis Naoiri (Kyushu, Japan)



Silicic acid 230 mg/l Lithium 0,6 mg/l Magnesium 268 mg/l

**0,5 l per** day fulfill the amount needed for prevention of AD

•Silicic acid 115 mg

- 11%-risk-reduction for each 10mg
- •Lithium 0,3 mg
- •Magnesium 134 mg)



# Thank you for your attention and let us work together



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